The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 57
Feb. 1922
No. 673

LONDON : PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

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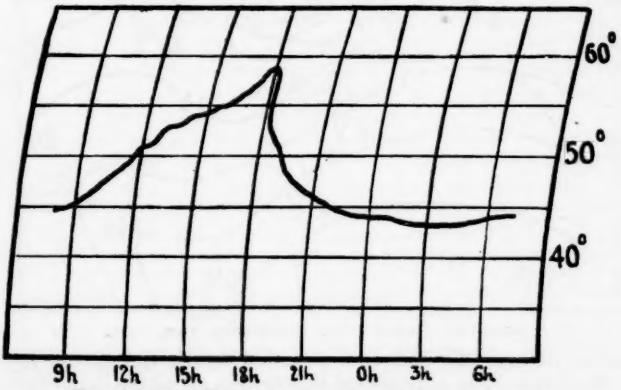
A Sudden Fall in Temperature : Ross-on-Wye, November 2nd, 1921.

By Miss L. F. LEWIS.

ON November 2nd at about 6.10 p.m., the thermogram at Ross-on-Wye (*see* Fig. 1) showed a remarkable fall of temperature. During the day the temperature rose steadily until 6 p.m., when the maximum, 59° F., occurred. A quite light, northerly wind then set in and in about 10 minutes the

FIG. 1.



THERMOGRAM, ROSS-ON-WYE, NOVEMBER 2ND, 1921.

drop of temperature could be distinctly felt; by 6.30 p.m. the reading was only 53° F. and by 9 p.m. 46° F.

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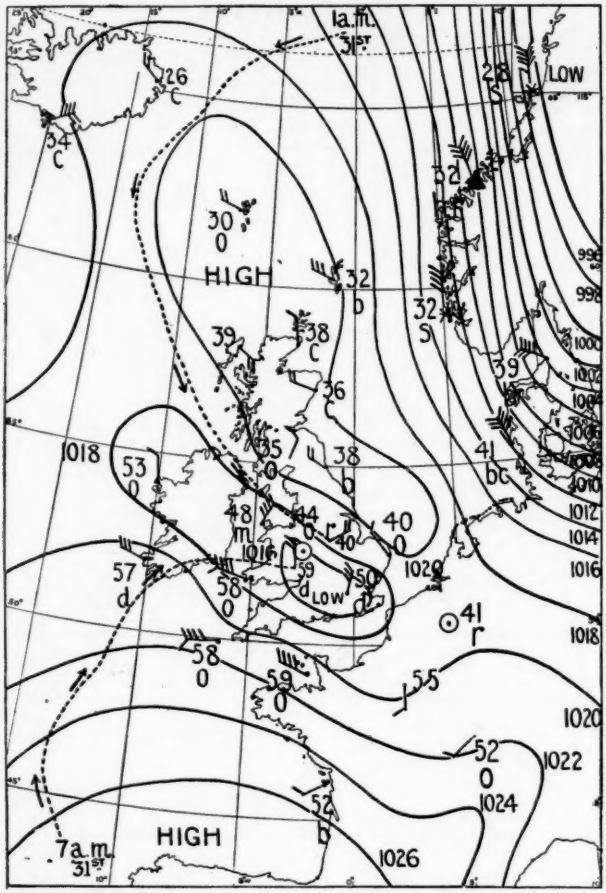
As can be seen from the 7 a.m. chart for that day there was a very marked difference in temperature south-west and north-east of a line drawn across the country from Blacksod Point to

FIG. 2.



SYNOPTIC CHART, 18H., NOVEMBER 2ND, 1921.

Folkestone and this difference persisted during the greater part of the day. It is still shown in the 6 p.m. chart here reproduced (Fig. 2), when the temperature at Ross was 19° above that at Nottingham.

Upper air temperature observations taken at Leuchars in East Scotland indicate that temperature up to 6,000 feet was

well below the normal. At about 2,000 feet there was a deviation from the normal of −11° F. at 7.30 a.m. and of −7° F. at 3.30 p.m. This shows that there was a solid current of cold air and that the cold air in the north was not merely a surface effect due to radiation.

In the diagram the two pecked lines are the trajectories* (geostrophic) of the air which reached Ross and Nottingham on the morning of that day. They suffice to explain how the sharp contrast of temperature arose which enabled the very light breezes of the shallow depression indicated on the map to cause a very great change of temperature in quite a short time. The air over Ross during the afternoon had come from the warm Atlantic a little north-westward of the coast of Portugal, while that at Nottingham had its source in cold, Arctic regions. It was evidently the replacement of the warm air at Ross by this cold air which caused the sudden fall in temperature. Observations at Malvern, a little less than 20 miles north-east of Ross, show that the cold air had reached that station by 5 p.m., the temperature being only 44° F., consequently the isotherms must have been exceptionally close together at about that time.

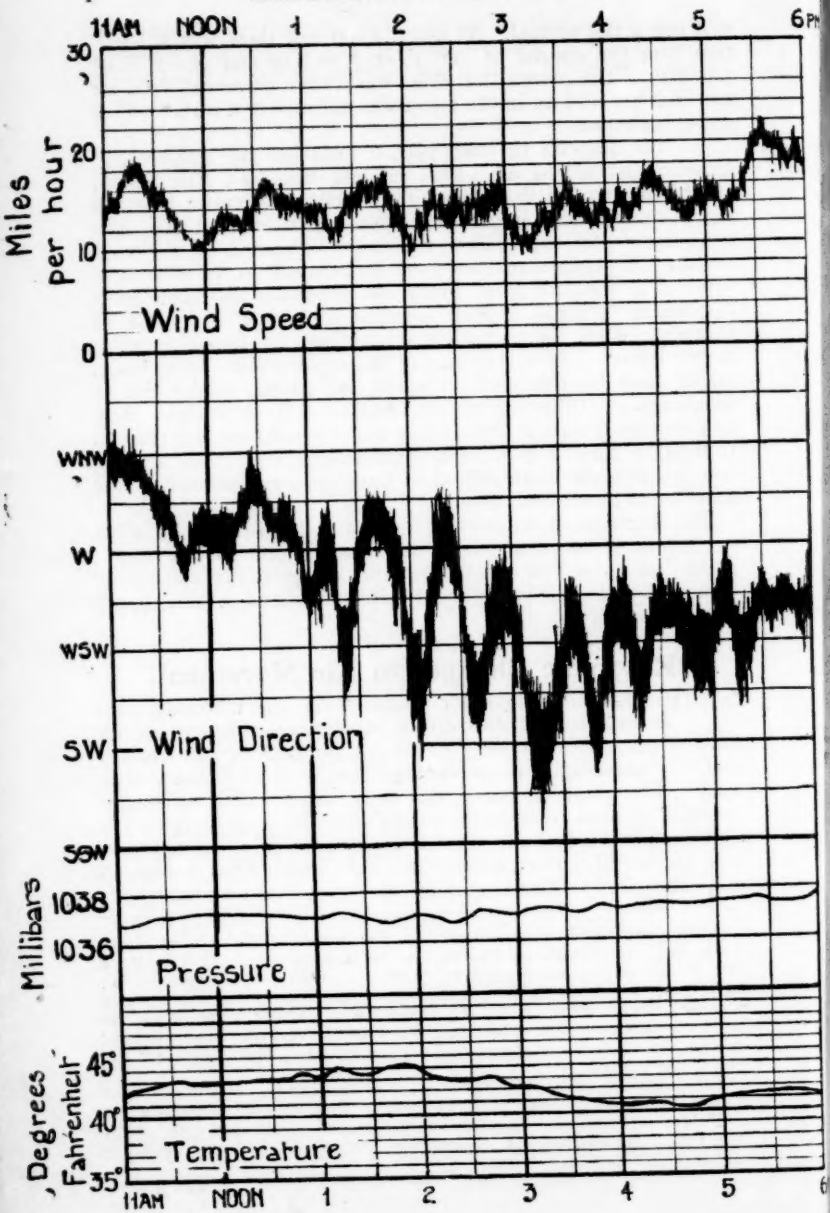
The incident is interesting in that it illustrates to what extent the temperature of air can depend upon its past movements, and also how the temperature changes characteristic of a line squall can be brought about without a line squall actually occurring.

Rhythmic Changes in Air Movement.

THE diagram which is reproduced on the following page is an excellent illustration of rhythmic changes in air movement. It has been constructed by copying the records made by autographic instruments at Southport on January 11th, 1907. The pressure curve has been drawn with twice the original vertical scale, the others are direct tracings. The instruments utilised are the Dines Pressure-tube anemograph, the Baxendell Direction-recorder, the Dines Float-barograph and the Dines Thermograph; the two wind-recorders are

* The geostrophic trajectories, *i.e.*, the paths of the air at about 1,500 feet, were found by tracing the air back in 6-hour periods along the isobars of successive working charts. The geostrophic velocity, V, of the air is calculated from the pressure gradient, γ, by the formula $\gamma = 2\omega V\rho \sin\lambda$, where ρ = air density, ω = angular velocity of the earth's rotation, and λ = latitude. In drawing the trajectories the air motion for each 6-hour period was taken as along the isobars for the end of the period.

For a detailed account of the method of drawing trajectories reference should be made to Shaw and Lempfert: *Life History of Surface Air Currents: A Study of the Surface Trajectories of Moving Air.* M.O. No. 174. An example of geostrophic trajectories may be found in Geddes: *Meteorology*, p. 211.


11AM
NOON
1
2
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6PM
Miles per hour
30
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Wind Speed
WNW
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Wind Direction
Millibars
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1036
Pressure
Degrees Fahrenheit
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Temperature
11AM
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at Marshside, the other two instruments at the Fernley Observatory about a mile to the south. Attention may be called to the advantage of the very open scale of the direction-recorder. In reference to such oscillations as are shown in this diagram Mr. Joseph Baxendell has communicated the following note :—

"I should like to put on record the following facts regarding these rhythmic changes of wind over the exceptionally level and open coastal district of Marshside, Southport :—

1. I doubt if they ever occur unaccompanied by a train of air-pressure waves, but the latter may not, always, at the same time, have the same period as the wind oscillations. Very generally, however, they have. In cases of difference, *e.g.*, when the period is altering during a series, air-pressure *precedes* wind.

2. Air-pressure waves of these rhythmic types frequently occur without any corresponding oscillations of wind.

3. The wind waves sometimes appear, in definitely symmetrical form, in wind speed only, sometimes in direction only, but often in both. When so in one of these elements only, there may even be no trace of any in the other element. But I think the air-pressure waves always appear. The state of the atmosphere, as regards cloud, haze, and visibility, seems to be quite immaterial.

4. They may occur in wind from any direction whatsoever. West, however, produces the finest examples.

5. Almost all of them arise in anticyclonic protuberances.

6. Near the north-western quadrants of large cyclones moving eastwards, they merge, almost insensibly, into hail-squalls. There is other evidence tending to indicate that they are more probably approximately circular whirls or eddies, than cases of wave-motion. Yet it is difficult to reconcile their sometimes beautiful symmetry of succession, with this hypothesis.

7. They occur much more frequently in some years than in others. Long intervals may elapse without any. Local diurnal winds completely destroy, or mask, them; hence they are rarely recorded in summer, except during the night, or on very cloudy days."

The Royal Meteorological Society.

THE Annual General Meeting of the Society was held on January 18th, at 49, Cromwell Road, South Kensington, Mr. R. H. Hooker, M.A., F.S.S., President, in the chair.

The Report of the Council for 1921 was read and adopted and the Symons Gold Medal, which is awarded biennially for distinguished work in connection with Meteorological Science, was presented to Col. H. G. Lyons, F.R.S. In making the presentation, the President laid stress on the importance of Col. Lyons's organisation of the Egyptian Meteorological Service and on his researches in the climatology of the Mediterranean Basin.

The Council for 1922 was duly elected, the new President being Dr. Charles Chree, F.R.S. The retiring President, Mr. R. H. Hooker, delivered an Address on "The Weather and the Crops in Eastern England, 1885–1921."

The object of this address was two-fold: firstly, to determine by the method of correlation, on the basis of the 35 years 1885–1919, which were the critical periods in the growth of the farm crops; and, secondly, to ascertain how far each such period was responsible for the actual crops harvested in each year. Mr. Hooker showed how wheat was most seriously affected by wet weather at sowing in autumn and winter; while warmth in winter was beneficial. The chief requirement of barley was a cool, dry, early summer, whereas for oats the same period should be wet and cool. Turnips wanted rain about June, but cool weather was even more important; and for hay the fundamental necessity was rain in the late spring. The author emphasized, however, that a cool summer was more important than rainfall for almost all crops, excepting only hay, and even that was the better for cool weather. The requirements of potatoes were practically the opposite of all other crops. For quality of seed, absence of rain, and in some cases warmth, was desirable. One feature which strongly emerged was that, as regards bulk of corn, the east of England was too wet (except for oats and beans) and too warm. The author then showed how the worst years, particularly 1893 and 1911, had been due to hot, dry summers, and the same feature was the cause of the generally bad crops of 1921; though wheat, which can stand any amount of heat and drought, was in this year a record. As a type of a good, all-round year he selected 1902, characterised by prolonged cool weather throughout the spring and summer, accompanied by rain until June, and followed by dry weather afterwards—exactly the combination most desired. In the east of England 1920 had a cool summer, only partly spoilt by rain in July, and the resultant crops were mostly good; but the rest of England had much worse crops. The fifteen years 1895–1910 constituted on the whole a period of good crops, but in the last seven or eight years, which have been chiefly notable for dry, warm springs, we have had a succession of very unfavourable weather conditions.

Discussions at the Meteorological Office.

Jan. 23rd, 1922. *Some Measurements of Atmospheric Turbulence.* By L. F. Richardson. (Phil. Trans. Roy. Soc., A. Vol. 221, pp. 1–28.) Opener.—Major G. I. Taylor, F.R.S.

MR. RICHARDSON'S researches on turbulence, which had been before the meeting of December 12th, provided ample material for further discussion at the January meeting. In the paper which was under review on this occasion the actual mechanism of turbulence is considered, the object being to compare the rate of transfer of visible material, such as smoke or thistledown, with that for momentum or temperature. The advantage of dealing with the movement of material objects is that the paths of the single individuals can be followed. Mr. Richardson has established the rule that, in turbulent motion which is the same in character at all heights, the average vertical displacement of a particle varies as the square root of the time. This rule is subject to the condition that the time considered must be considerably longer than the average time of rotation of an eddy. A simple deduction is that, allowing for the horizontal movement of the air, the matter which starts from a single spot spreads out in such a way that it lies half inside and half outside a surface which is a paraboloid at a considerable distance from the source, but is conical near the source. Photographs of smoke obtained with a long exposure bear out this theoretical result. Major Taylor, who summarised the paper, pointed out that the argument in one important section of the paper was unfortunately vitiated by two complementary mistakes—[Equation V (3): there should be a minus sign on the left; p. 10, l. 5: the correlation does not vanish].

He also criticised some theoretical deductions from pilot balloon observations (Table 1), which indicate that the drag exerted by wind on the ground is not in the direction of flow of the air, but may be inclined to it at a large angle. Unfortunately, considerations of space had led to the omission of any detailed description of the method by which the results in question had been reached; in the subsequent discussion Mr. Richardson, who admitted the difficulty involved in accepting the results, expressed the opinion that they should stand as a challenge to further investigation.

Feb. 6th, 1922. *Applications of Heat Radiation Measurements to the Problems of the Evaporation from Lakes and the Heat Convection at their Surfaces.* By A. Ångström. (Geographiska Annaler, II., 3, 1920.)

The Evaporation from the Sea. By G. Wüst. (Institut für Meereskunde, Berlin, Oct. 1920.) Opener.—Mr. M. A. Giblett.

DR. ÅNGSTRÖM attacks the problem of determining the evaporation from a large body of water by considering the heat exchange at the surface. The net gain of heat in a given time from radiation and convection is used partly in changing the temperature of the lake and partly in evaporation. If all but one of the quantities involved can be determined, the remaining one can be deduced. Working with data concerning a certain small lake in Sweden, Ångström selects in the first instance occasions when the air is at the same temperature as the water, so that convection is negligible and, by utilising his knowledge of the incoming and outgoing radiation, as well as information concerning the rate at which the temperature of the lake is changing, he obtains an estimate of the rate at which evaporation must have been taking place. Further, by analysing the circstances when water was warmed by the air and utilising Witting's formula for evaporation, Ångström arrives at a probable value for the rate of loss of heat by convection. He shows that for each degree centigrade in the excess of water-temperature above air-temperature this loss of heat is of the order of ·01 gramcalorie per square centimetre per minute. The rate of gain of heat by the water, when cooler than the air, is much smaller.

Dr. Wüst, relying on measurements made with evaporimeters on ships, discusses the zonal distribution of evaporation. After appropriate reduction, these observations suggest that evaporation is most rapid between the latitudes 10° and 20° north and south, where it amounts to about 1100 mm. in a year. The rate in the cloudy equatorial belt is rather lower. In latitude 55°, about 400 mm. of water evaporate annually. Comparison between these estimates of evaporation and the data available for the rainfall over the oceans indicates that evaporation exceeds precipitation between latitudes 40° N. and 40° S., except at the equator, but outside these limits precipitation is in excess. The difference is highly correlated with the surface salinity. Wüst's results show good agreement with some determinations by Mr. Giblett from different considerations.*

The discussion indicated that, while the results give the order of magnitude of evaporation in various regions, there was considerable doubt as to their finality. An interesting contribution to the discussion was a note, read by Mr. Harwood, from Dr. C. W. B. Normand relating to evaporation from the Arabian Sea during the monsoon.

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* See *Meteorological Magazine*, Jan. 1922, p. 363.

Correspondence.

To the *Editors, Meteorological Magazine.*

Maximum Temperatures on Winter Nights.

A MARKED characteristic of the climate of the British Islands is the liability of the maximum temperature in the twenty-four hours to occur by night in certain types of weather during the period of the winter solstice. When, as so often happens, during the long night in November, December, January, and, perhaps, February, a waft of damp heat from the Atlantic Ocean sends the thermometer suddenly up to near 55° F., this is almost sure to prove the maximum for the twenty-four hours if frosty, polar air begins to creep down over the country during the ensuing day-time, at a season of the year when solar radiation counts for little. I want to suggest that when these cases occur the emphasis should be laid, not on the *absolute rarity* of maxima at night, which is a commonplace, but on the *relative frequency* of night maxima in the depth of winter, because this is really the interesting climatological feature which ought to be portrayed. Statistical evidence bearing on this point may be found in Mr. M. A. Giblett's paper (*M.O. Professional Notes*, No. 22. A Comparison of Minimum Temperatures, &c., 1921) in which it is shown that the month with the greatest frequency of such inversions of the normal diurnal range of temperature is December, as one would expect. Winter-nights between 50° and 60° F. are, of course, warmer than many a night in summer: but such warmth is typically of a damp, stormy character with frost in its wake, as the equatorial current is replaced by polar air. L. C. W. BONACINA.

27, Tanza Road, London, N.W. 3, 17th December 1921.

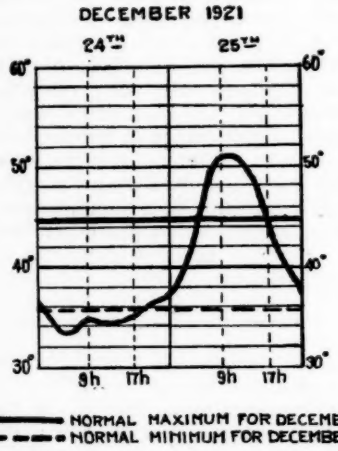
[The question raised by Mr. Bonacina is of special importance in view of the recent introduction of the system of publishing day-maxima and night-minima instead of the extremes for the 24 hours. This system is now adopted in the *Daily Weather Report* for all the telegraphic stations and for the health-resorts. The monthly returns of the observations at the health-resorts are contrived so that the occasions on which the maximum temperature from 9 h. to 9 h. exceeded that from 9 h. to 17 h. may be seen at a glance, as also the occasions on which the minimum temperature for 17 h. to 17 h. was below the minimum for 17 h. to 9 h.

Mr. Bonacina points out that December is the month in

which such anomalies are to be expected. In the following table data for December 1921 are set out:—

Station.	Frequency of Occasions during December 1921 with—		Maximum Temperature assigned to December 24th, 1921.	
	Maximum 9 h.–9 h. above Maximum 9 h.–17 h.	Minimum 17 h.–17 h. below Minimum 17 h.–9 h.	9 h.–17 h. Dec. 24th.	9 h.–9 h. Dec. 24th–25th.
Brighton - - - -	9	5	38	50
Worthing - - - -	10	1	37	50
Ilfracombe - - - -	15	2	48	54
Margate - - - -	13	0	39	49
Malvern - - - -	10	2	40	46
Tunbridge Wells - - -	10	3	36	50

The excess of the numbers in the first column above those in the second is very striking. A partial explanation is that the interval 17 h. to 9 h. is twice as long as that from 9 h. to 17 h., so that in weather such that it is merely a question of luck whether an extreme occurs at one hour rather than another, the chances are 2 to 1 in favour of the night.



The misleading character of the practice of giving the extremes for 24 hours ending 9 h. and "throwing back" the maximum temperature is brought out by the figures for Christmas Eve, which are illustrated by the thermogram for South Kensington here reproduced.

In the south of England the day was cold and the maximum up to midnight was below 40° F. An influx of warm air occurred in the early morning and by 9 h. on Christmas Day temperatures of 50° F. were common.

By the 9 h. to 9 h. system this temperature of 50° F. is credited to December 24th.

The anomaly shows up in the figures reported for London on December 24th; the maximum temperatures were:—

Greenwich, 50° F.; Camden Square, 50° F.; Westminster, 51° F.; Kew Observatory, 38° F.; Hampstead, 38° F. The initiated will notice that the interval at the first three stations is 9 h. to 9 h., whilst for Kew it is 7 h. to 18 h. and for Hampstead 21 h. to 21 h.—ED., M.M.]

The Lapse-Rate of Temperature over the Sea.

THE review in the *Meteorological Magazine* of last month, of my paper* on evaporation, contains a criticism that the "dry adiabatic" lapse-rate of temperature (1° C. per 100 m.) employed in an example quoted "is not generally appropriate for air over the sea." This statement does not represent the result of experience, at any rate in sub-tropical and tropical seas, to which the example from my paper, with its sea surface temperature of 75° F., is applicable. As the point is of interest the observational evidence is briefly summarised below.

The aerological results of expeditions prior to and including the cruise of the German ship *Planet* in the Atlantic and Indian Oceans, 1906–1907, are summarised in the *Planet* report, from which the following extract, translated, has been made. After commenting on the agreement with previous results the report proceeds:—

> "In the lowest layers of the atmosphere over the ocean between the tropics and in their neighbourhood, the temperature of the air almost always decreases very rapidly with height: about 1° C. in 100 m. Of the ascents on S.M.S. *Planet* only one showed an average lapse-rate in the lowest half-kilometre as low as 0·5° in 100 m., three gave 0·7°, two 0·8°, eleven 0·9°, four 1·0°, eleven 1·1°, two 1·2° and three even 1·3°. The lapse rate was thus almost as often greater as smaller than the adiabatic rate for dry air."

It will be seen that of 37 observations 31 showed a lapse-rate of at least 0·9° C. per 100 m. An examination of the actual records shows that the steep lapse usually extended up to a level between a half and one kilometre above the surface, where it terminated with an inversion, and also that on these occasions the air temperature near the surface was in general equal to or less than that of the sea surface.

Some Problems connected with Evaporation from Large Expanses of Water. By M. A. Giblett, M.Sc. *Proc. Roy. Soc.* A. Vol. 99, 1921.

These results have been confirmed by simultaneous and subsequent expeditions, in particular those of the *Otaria* (Teisserenc de Bort and Rotch), 1905–1907, that from Lindenberg to East Africa in 1908 and that of the *Möwe* in 1911. Clayton, who summarised the results of the *Otaria* cruise, mentions as his first conclusion " a rapid decrease of temperature with adiabatic gradient from the sea up to a height of some hundreds of metres." The termination of the steep lapse by an inversion was also a feature of these ascents, the height of the inversion being above 500 m. in latitude 35° N. and decreasing towards the equator.

The " dry adiabatic " lapse of temperature is merely a state of neutral equilibrium which is readily established by supplying heat at the surface, as over land on a sunny day, and may even be exceeded so long as the supply is maintained at a sufficiently rapid rate. A body of water, with its large capacity for heat, is very effective in supplying heat to relatively cold air flowing over it, and under such conditions, an adiabatic lapse-rate is probably by no means uncommon in the first half kilometre or so over the sea in any latitude. This would apply particularly to " polar air " flowing southwards and changing its latitude quickly, and the cumulo-nimbus cloud and hail showers which are often observed in it over the sea are evidence of its instability.

High lapse-rates in the first few hundred metres have been observed from a ship by Mr. W. H. Dines at Crinan and by Dr. G. C. Simpson over the North Sea, while the *Planet* report mentions that during a summer cruise in the neighbourhood of Spitzbergen, Prof. Hergesell frequently observed lapse-rates as great as those usual in tropical regions. Thus a " dry adiabatic " lapse of temperature in the lowest layers would be by no means an unreasonable assumption for conditions over the sea in any latitude and is particularly appropriate in the tropics.

M. A. GIBLETT.

West Hampstead, N.W.6, January 30th, 1922.

The End of the Drought?

OUR springs here commenced to run—or, as the local expression is, " created "—last week and many wells now have water in them. This being the case the long drought may be considered over as far as the Thames is concerned. Whether there is any shortage of water in the late summer or autumn will now depend on whether we have good rains in March or April. At present we have daily rain. CHARLES P. HOOKER.

Cirencester, January 27th, 1922.

Sheet Lightning observed at Sunbury on the night of January 24th–25th.

SHORTLY after 2 a.m. yesterday morning, January 25th, I was aroused by flashes of light coming through my window. On getting up I witnessed a display of sheet lightning quite unusual at this period of the year and probably rarely equalled for brilliance even in the summer months. The flashes, which were at first seen in the north, followed one another in quick succession, lighting up the whole countryside and producing a weird effect. They worked round gradually to the west and then to the south-west. After a short lull, the lightning recommenced in the north and afterwards appeared to come from all directions. The open exposure in all directions from my house enabled me to observe this display to great advantage. When I retired finally about 2.45 a.m. the lightning was still in progress though less brilliant. It is curious that no reports of lightning were received by the Forecast Service of the Meteorological Office. I heard, however, that it was seen between 11 p.m. and midnight in North London.

The lightning was, doubtless, associated with the change in the source of the air supply over this area, which took place about this time, a warm current arriving from the south. At Croydon the thermometer, which had been steady at 26° F. for some time, commenced to rise at 11 p.m. and rose 4·5° in 4 hours. By 7 a.m. a temperature of 33° F. was recorded. The wind, however, continued easterly.

It is interesting to note that reference to a similar phenomenon is made by Dove* as early as 1862. Referring to the storms of January, 1818, he states: "At Dantzic . . . the temperature on the next morning (the 4th) was −4° with a SSE wind. In the course of the succeeding night, sheet lightning heralded the approach of the equatorial current which came on during the night of the 6th as a S wind, and then shifted through SSW to W, bringing on a thaw." F. ENTWISTLE.

Sunbury-on-Thames, January 26th, 1921.

An unusual Optical Phenomenon.

ON Thursday, January 19th, 1922, occurred a remarkable optical phenomenon which I am at a loss to explain.

After intermittent rain and sleet for most of the day, the sky broke up at about 15h. into ragged fracto-stratus. At

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* *Law of Storms*, Scott's translation, p. 246.

15h. 30m. my brother saw a narrow beam of light extending upwards from the sun, which was near the horizon, nearly to the zenith. There was a mass of fracto-stratus about 15° above the sun, and the beam of light, which was of a reddish colour, passed *under* this, showing that its origin could not have been in ice-crystals in the upper air; indeed no cirrus was visible. The breadth of the beam, whose sides were approximately parallel, was rather less than the apparent diameter of the sun, its luminosity decreased as it rose in the sky, and it was visible in the haze above the horizon nearly down to the sun's upper limb. I saw the phenomenon myself at 16h. 15m. when the top of the beam was only some 20° above the horizon and the sun behind a cloud; it remained visible till 16h. 30m. In the old days it might well have been thought to have some special meaning, since it was followed by a week of the foulest weather, rain, sleet, fog and gloom, it has been my misfortune to record.

R. F. T. GRANGER.

Lenton Fields Climatological Station, Nottingham, January 27th, 1922.

A "Brocken Spectre" on Arthur's Seat.

AT about 11h. 40m. on December 29th, a fine but foggy day, when nearing the top of Arthur's Seat, at Edinburgh, I was interested to see an undoubted Brocken Spectre. I made some gesticulations to make sure that the dim shadow was mine, and these were repeated by the shadow. The haze was so great that everything beyond St. Margaret's Loch (900 yards away) was almost invisible, and the spectre did not seem so far away as this, but I could not make up my mind as to the distance at which I appeared to see it; it might have been about the distance of St. Anthony's Chapel (800 yards). The spectre seemed to be about 100 ft. high. I did not note any rings, coloured or uncoloured.

The phenomenon was best seen when I was standing within a foot or two of the top of the hill, and when I stood on the iron plate that marks the top of the hill the "spectre" became a pillar, but owing to the high wind, I did not repeat the gesticulations.

In the ordinary explanations of the Brocken Spectre, as I have understood them, it is stated to be a shadow *on* a cloud, *i.e.*, the outline of the shadow would be a linear curve in space. But it seemed to me that the effect was a cumulative one, as if it was rather due to seeing lots of cloud particles in shadow, in line with the eye—as if the "shadow" were really not a curve in space but a *surface* in space, a cone with the apex to the observer's

eye. Hence it was not easy to tell at what distance the spectre seemed to be. It was somewhere between the point where the opacity of the haze was so great that no light was being reflected to the eye, and a point so near the eye that the difference in luminosity of the particles in sun and shade was not sufficiently marked to be noticeable.

As the result of the experience I feel that I understand the spectre in a way I never could before, when I thought of it as a shadow at a definite distance on a definite object.

With so many motor cars about with powerful lamps, spectres akin to the Brocken should nowadays be one of the commonest of artificial meteorological phenomena, but the sun-formed spectre itself should not be uncommon on eminences near smoky towns.

M. M'CALLUM FAIRGRIEVE.

The Edinburgh Academy, January 23rd, 1922.

Weather Lore.

IN meteorology we are familiar with a number of saws (wise and otherwise) derived from the experience of seamen and landsmen. Some of the adverse criticisms which these saws meet with may be accounted for by the special localities which supplied the experience on which they were founded, just as Hooke's legends on the wheel-barometer are not so suitable for Buxton or for Paris (and I have found them displayed in both places) as they are for London, where Hooke lived. The sayings in Mr. Inwards's collection are for the most part simply chronological not local; I mean that time is the only variable considered.

Coming home from Bergen last summer, the Captain of the *Jupiter* gave me one of a new kind: that the weather always changes in crossing from the Norway Deep to the shallower water. I think I have an explanation of that as part of the general influence of coast lines on weather. Captain Hepworth used to insist that the weather changed with the turn of the tide; neither he nor I could suggest an explanation. A layer of water 20 feet thick has some potential effects, but what they are no one seems to know.

What I write for now is to ask whether any readers of the Magazine, sailors or landsmen, can mention any other weather-maxims representing the effect of special localities. The world over, there must be a good number which have not yet got themselves recorded.

NAPIER SHAW.

School of Meteorology, January 17th, 1922.

NOTES AND QUERIES.

A Note on the Meteorological Conditions affecting Scent.

THE following note was prompted by the apparently well-founded opinion that the degree of scent obtained in the hunting field must depend upon the meteorological conditions prevailing at the time of the hunt.

The degree of scent prevailing upon the various days on which hunting took place during the period August 30th, 1920, to March 2nd, 1921, was kindly provided by the members of the Belvoir and the Blankney Hunts, notably by Major T. Bouch, the Master of the Belvoir, and by Squadron Leader A. H. James, R.A.F. Other scent data used were provided by members of the Cranwell R.A.F. Beagles.

Theoretically, on the assumption that scent consists of small material particles reaching the noses of the hounds, it would appear that the meteorological conditions making for good scent would be those which would keep the material particles down to the level of the hounds. These conditions would seem to be :

(*a*) the absence of convection currents of air upwards ;
(*b*) a high relative humidity ; and
(*c*) the absence of wind.

Condition (*a*) would come into play if the temperature on the ground were lower than that at a height of 2 feet, for then there would be no tendency for the lower air to rise, as it would be of greater density than the air at 2 feet. Condition (*b*) might be a condition of good scent if the particles happened to be hygroscopic, for the collection of moisture on them would weigh them down. Condition (*c*), the absence of wind, would operate by eliminating an agent which would dissipate the scent particles over a large area and thus diminish their intensity.

Classification.	Number of Occasions.	Proportion of Good Scents.
		per cent.
All observations - - - -	53	54
GROUND-FROST on previous night - - -	10	80
TEMPERATURE* at 2 ft. higher than that at ground	36	58
„ „ lower „ „ -	9	22
RELATIVE HUMIDITY { not below 85 per cent. -	30	70
RELATIVE HUMIDITY { below 85 per cent. - -	23	50
WIND SPEED at 40 ft. { exceeding 7 m.p.h. -	39	50
WIND SPEED at 40 ft. { not exceeding 7 m.p.h. -	14	64

* Temperature data were not available on 8 occasions.

The meteorological conditions prevailing upon each hunting day were compared with the degree of scent experienced during the day. The results are shown in the following Table, 53 "scents" being available in all. The temperatures on the ground and at 2 feet were determined as near as may be by fully exposed thermometers.

It would seem, too, that ground-frost just before a hunt should mean good scent inasmuch as it probably connotes that the actual ground is colder than the air at 2 feet, and consequently that no upward currents are set up. This is borne out by the actual results obtained. Ten hunts occurred immediately after ground-frost and eight of these were accompanied by "fair" or better scent.

Due weight must be allowed to the shortness of the period examined, making general results unjustifiable. Granting this, the Table shows that no one meteorological element stands out as accompanied, always, or nearly always, by a high degree of scent. Nevertheless, it seems to be true that a fair or good scent is probable when the following conditions hold:

(*a*) the absence of winds over 7 m.p.h.;
(*b*) a relative humidity of over 85 per cent.;
(*c*) the presence of an "inversion of temperature" at ground level; that is the temperature of the ground being lower than that at 2 feet;
(*d*) the presence of a ground-frost.

W. H. PICK.

Climate and Clothing.

AN interesting discussion of "Thermal Sanitation in the Tropics" is given by Mr. G. W. Grabham in the *Journal of Hygiene*, Vol. XIX., No. 3. Mr. Grabham has carried out a number of experiments in Khartoum to test the heat-absorbing properties of various materials and fabrics and has investigated in less detail the translucency and porosity of materials used for clothing. Perhaps the most striking point brought out by the investigation is the great amount of heat absorbed by khaki materials. White drill exposed to the sun has a temperature about 11° C. above that of the air, thin khaki drill 29° C. above, thick khaki drill 33° C. above, black cotton cloth 41° C. above. With regard to porosity and translucency, white calico proves to be by far the most satisfactory material. Khaki may be a useful colour in so far as it is inconspicuous and durable, but it cannot be recommended from a hygienic point of view, and khaki uniform must cause unnecessary discomfort.

The great benefit to be derived from whitewashing walls and roofs is also shown. Whitewash is the ideal "paint," but white oxide paint is nearly as good.

The historical summary given at the end of the paper is interesting, and it is remarkable that Mr. Grabham has been able to consult such a variety of scientific works in the heart of Africa. We notice, however, that Dr. Leonard Hill's reports do not seem to have been available.

Storm Floods.

THE overflowing of the Thames in London in November 1921 and the floods which occurred at Hull in December were due to rises in level in the North Sea under the influence of northerly gales which happened to coincide with spring tides, and provide examples on our own shores of a phenomenon which is frequently observed in varying degrees of intensity in the Baltic Sea. According to the *Segelhandbuch der Ostsee*, published by the "Reichs-Marine-Amt," from which the following information is taken, tides are practically non-existent in the Baltic, and the surface currents nearly always follow the wind direction with a slight deflection to the right owing to the earth's rotation. Alterations in level are, therefore, almost entirely dependent on changes in the wind and are quite perceptible even with light winds, the tendency being to pile up the water on any given part of the coast when the wind comes off the sea and to depress the water level on the coast when the wind is from the land; floods (Sturmfluten) occur when the wind reaches storm force. Storm floods are most frequent in the south-western part of the Baltic, where the dangerous winds are those from east and north-east. In November 1872 the water rose at Lübeck and Wismar during a storm to a height of 3 or 4 metres above its normal level and inundated wide stretches of the coastal districts. Considerable damage was caused to property, and some of the dunes on the sandy coasts of Pomerania and Mecklenburg were almost completely washed away. Similar floods occurred in the years 1625, 1694, and 1784.

Another closely connected phenomenon is the sudden fall in temperature of the water on the Baltic coasts which occurs during the prevalence of a wind off the land. The warm surface water is blown out to sea, tending to cause a depression of the water level on the coast with a consequent upwelling of colder water from below. In the Gulf of Danzig in June 1889 a change in temperature from 70° F. to 46° F. was observed during a light southerly to south-easterly wind, but the temperature rose again after the wind had gone round to north. In this case, however, no appreciable changes in water level were recorded at Neufahrwasser.

J. WADSWORTH.

The Flight of Thistledown.

RECENT numbers of *Nature* contain interesting correspondence on the flight of thistledown. Professor Miles Walker of the College of Technology, Manchester, is of the opinion that fully-blown thistledown in sunshine has a positive lifting power, apart from any general upward current of the air. He suggests that the sun in shining on the fine cilia warms them and creates a small local current of warm air. Mr. W. E. Lishman, of Newcastle-upon-Tyne, cites an instance of the "hovering" of thistledown. On a very hot day with air still except for the quivering from heat, what seemed to be a dragon-fly was observed hovering five or six feet above the ground and frequently darting a foot or two away. The object was found to be a thread of thistledown about an inch in length. No current was noticeable, the movement, or the stationary quivering attitude, seemed to be independent. Mr. L. F. Richardson who has examined the flight of thistledown in his researches in atmospheric turbulence* states that he has frequently observed the rising of plant-down on calm sunny days and suggests that the upward motion is due to upward currents of air since the air is usually full of eddies on a hot afternoon. He also points out that in order to prove that the thistledown moves through and not with the air, it would be necessary to make simultaneous and contiguous measurements of air-motion by means of smoke or some special anemometer.

Prof. James Small, of Queen's University, Belfast, who has made a special study of the hydrodynamics of fruit dispersal† writes that a wind of 1 mile per hour will raise the pappose fruit of the dandelion, *i.e.*, the seed with its parachute, whilst for groundsel and coltsfoot horizontal currents of about $\frac{2}{3}$ mile per hour suffice. Naturally, the pappus alone would be lifted by a still slower current. It is interesting to notice that none of the investigators taking part in this correspondence have found it necessary to invoke the special forces postulated by Dr. Hankin‡ in explanation of the soaring flight of insects.

L'Institut de Physique du Globe.

IN the issue of this Magazine for February 1921, notice was given of the creation of L'Office National Météorologique by the unification of the three French Meteorological Services. This

* *Roy. Soc. Phil. Trans.* A. Vol. 221, 1920, p. 1. *See also* p. 6 *of this issue.*
† *Origin and Development of the Compositae.* Wheldon and Wesley, 1919.
‡ *Meteorological Magazine*, 1921, p. 43.

office is responsible for all meteorological questions, but other geophysical subjects, and in particular, terrestrial magnetism, are now dealt with by L'Institut de Physique du Globe. The institute, which is to be closely associated with the University of Paris, is still in process of organization, but the Director, Professor Maurain, hopes to proceed with the publication of magnetic data during the present year. The address, both of the National Office and of the Institute, is 176, *Rue de l'Université, Paris.*

Meteorology in German Universities.

We learn from *Nachrichten für Luftfahrer* that courses of instruction in aviation have been arranged in many of the German universities and technical colleges. Meteorology, theoretical or practical, occurs in the syllabus of thirteen out of the sixteen institutions mentioned. The list of lecturers includes the names of Kassner, Hellmann, Hergesell, Wiechert, Wenger, Georgii, Peppler and Schmauss.

International Aerological Soundings.

A list of the dates fixed for the international balloon days has been received from the International Commission for the Scientific Investigation of the Upper Air. The dates are given in the following table, which supplements that given on p. 216 of the last volume of this magazine. The dates in heavy type are those on which two ascents daily are to be made.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1922	**17–19**				15–20				11–16			
1923		12–17				**12–14**				15–20		
1924			17–22				14–19				**11–13**	
1925				**14–16**				17–22				14–19
1926	11–16				17–22				**14–16**			
1927		**15–17**				13–18				17–22		
1928			12–17				**17–19**				12–17	

The Care of Thermograph Coils.

Enquiries as to the treatment of bimetallic coils of thermographs in order to prevent corrosion are sometimes received at the Meteorological Office. Observers may be interested to know,

therefore, that a thermograph, the coil of which was coated with Jenson's air-drying enamel, was brought into use at an out-station in December, 1920. In June, 1921, the observer reported as follows :—" While the condition of the coil of the thermograph is very much better than it would have been without the enamel, there are some traces of rust showing. The use of the enamel has certainly been justified. In my opinion the sensitivity of the thermograph has not been affected to any appreciable extent." Robbialac black enamel is also suitable for the purpose. Before applying the enamel, great care must be taken thoroughly to clean away, as far as possible, all grease and rust which may adhere to the coils, completing the preparation for enamelling by washing with petrol.

The Multi-Scale Thermometer.

THERMOMETERS provided with an ingenious arrangement of six scales have recently been made by Messrs. Negretti and Zambra to the specification of Prof. McAdie, who has very kindly presented a specimen to the Meteorological Office. The observer provided with such a thermometer can read at will the temperature on the Fahrenheit, Centigrade, Absolute or Kelvin-Kilograd scale as well as the saturation vapour-pressure in kilodynes per square centimetre, and the weight of saturated vapour in grams per cubic metre.

Review.

Rainfall in the Southern Pennines, Vol. I. No. 9. Annual Summary: 1918. By A. A. Barnes. Size, 9 × 10½ in., pp. 35 + 58; 2 maps.

MR. BARNES'S monthly summaries of the rainfall in the Southern Pennines have not appeared since 1918. We are glad to see that he is now publishing his annual summary for that year.

This pamphlet, though slender in size, is the outcome of a great amount of assiduous labour. The data are mostly arranged in tabular form as in *British Rainfall*, with convenient map references to facilitate locating the stations, and in nearly every case there is added the actual or computed average value for the period 1865–1908, and the percentage of this amount which fell during 1918. This period is selected as giving the closest approximation to the true normal rainfall.* It is to be feared, however, that in many cases faulty rain gauge exposure has vitiated the average values, for the geographical distribution of the percentage values shows some irregularities which would be difficult to explain on any other hypothesis. In spite of this minor defect the two maps showing respectively the distribution

* See *Q. J. R. Met. Soc.*, Vol. XIV., p. 209.

of actual rainfall during the year, and that of the fall in its relation to the average are valuable contributions to detailed rainfall mapping. They show clearly that the district under review is one of greatly varying precipitation, and provide a study of the relation between rainfall and the configuration of the land, which is in some respects unique. We heartily congratulate Mr. Barnes and the Manchester and Stockport Rainfall Organization and hope that the publication will be continued on similar lines.

Obituary.

Sir Ernest Shackleton, C.V.O.—The news of the arrival at South Georgia of the *Quest* carrying the Shackleton-Rowett Antarctic Expedition was being awaited with some anxiety, when a cable from Montevideo announced that she had reached that gateway of the Antarctic seas and that the leader, Sir Ernest Shackleton, had died on January 5th of a heart seizure with appalling suddenness. The *Quest* proceeded on her voyage, as provided in the original plans, under the command of Commander Frank Wild, and the body of the great leader was accompanied to South America by Captain Hussey, the meteorologist of the expedition. It has been arranged that the remains shall be taken again to South Georgia for interment.

The career of Sir Ernest Shackleton as an Antarctic explorer began at the age of 26, when he sailed in Captain Scott's first expedition on the *Discovery* in 1901. Brought up to the sea and fired with the love of adventure, Sir Ernest threw his whole heart into the advance of discovery in the far south. He accompanied Scott on his southern journey on the Great Ice Barrier and, although attacked by serious illness on the return, he struggled on until the base was reached.

He was invalided home before the second winter of the expedition, and in 1904 he became secretary of the Royal Scottish Geographical Society and attained great proficiency as a popular lecturer. In 1907 he set out on an expedition of his own, financed by the guarantees of friends, and free of any external control, with the avowed intention of reaching the South Pole. He relied on new methods of transport and a new dietary, and would have succeeded had not the last of the ponies, on which he depended for food after it was no longer useful for transport, fallen down a crevasse in the Beardmore Glacier. He did succeed in reaching 88° 24′ S. on the great plateau, 10,000 feet above sea-level, and only 97 geographical miles of easy going from the Pole. The scientific results of the expedition were of the utmost value, though the meteorological data have not yet

been published in full. We understand that the material, together with that of the following expedition, is now in the hands of Mr. R. C. Mossman for complete discussion.

After Shackleton had collected money enough to pay all the debts of the expedition by lecturing and showing his kinematograph views, for it was he who introduced this form of photography in the Antarctic, he planned a new and more ambitious exploit. He meant to cross the Antarctic continent, but his ship, the *Endurance*, was caught in the ice of the Weddell Sea, and after long drifting was lost. The amazing dash and resourcefulness as a leader of successful advance had not prepared the public for Shackleton's prudence and caution in conducting an almost hopeless retreat; but it was in him to achieve greater fame in retrieving loss than even in following up success. His work was fully noticed in these pages (Vol. 51, 1916, p. 113) at the time: it appears even more magnificent in retrospect. Returning to England in 1917, Shackleton joined the North-Russian expeditionary force, and as soon as the return of peace set him free, and his lectures on the *Endurance* expedition enabled him to pay off its cost, his ever-active brain conceived his last great venture. The event shows that he overestimated the power of an ever-young mind to control a body which, in spite of great strength, had been sorely tried by twenty years of almost superhuman toil and hardship.

He was a man who pioneered the way for scientific research, but he laid his countrymen under a greater debt by his embodiment of the spirit of romantic adventure, showing that it could flourish as gloriously in the twentieth century as in the time of Queen Elizabeth. He won the affection of all he commanded, but he never lost their respect, and those who had gone with him once were always the most eager to follow him again. He was an inspiring leader and a faithful friend whose memory will live with the fame of the greatest discoverers of all time.

H. R. M.

Father Giuseppe Lais, S.J.—The death is announced of Father Giuseppe Lais who had acted as vice-director of the Vatican Observatory since 1903. He was also vice-secretary of the Accademia dei Nuovi Lincei at Rome for many years.

Father Lais was the author of a long series of papers on meteorology, mediæval and modern, astronomy and calendar reform, and he has published some little-known meteorological records of the sixteenth and seventeenth centries.

Professor Robert Wenger, Director of the Geophysical Institute of the University of Leipzig, died on January 20th, 1912. Prof. Wenger, who succeeded Prof. V. Bjerknes as Director of the

Institute, had maintained the high level of its work, and was himself the author of several important papers on Dynamical Meteorology.

News in Brief.

A NEW feature has been introduced in the January number of the monthly fly-sheet issued as the *Supplement to the Daily Weather Report*, a diagram showing the day-maxima and night-minima at Kew Observatory.

MR. F. J. GURNEY, who measures the water drained from farm-land at Ridgewell, Essex, where there is a substratum of heavy clay soil, reports that the outflow which had ceased on February 2nd, 1921, recommenced on January 19th, 1922.

Conquest for December 1921 contains a popular illustrated article on "The Exploration of the Upper Air" by Mr. W. G. W. Mitchell of Newbury Grammar School.

ON December 8th Lord Rayleigh read a paper on the "Aurora Line in the Spectrum of the Night Sky" before the Royal Society.

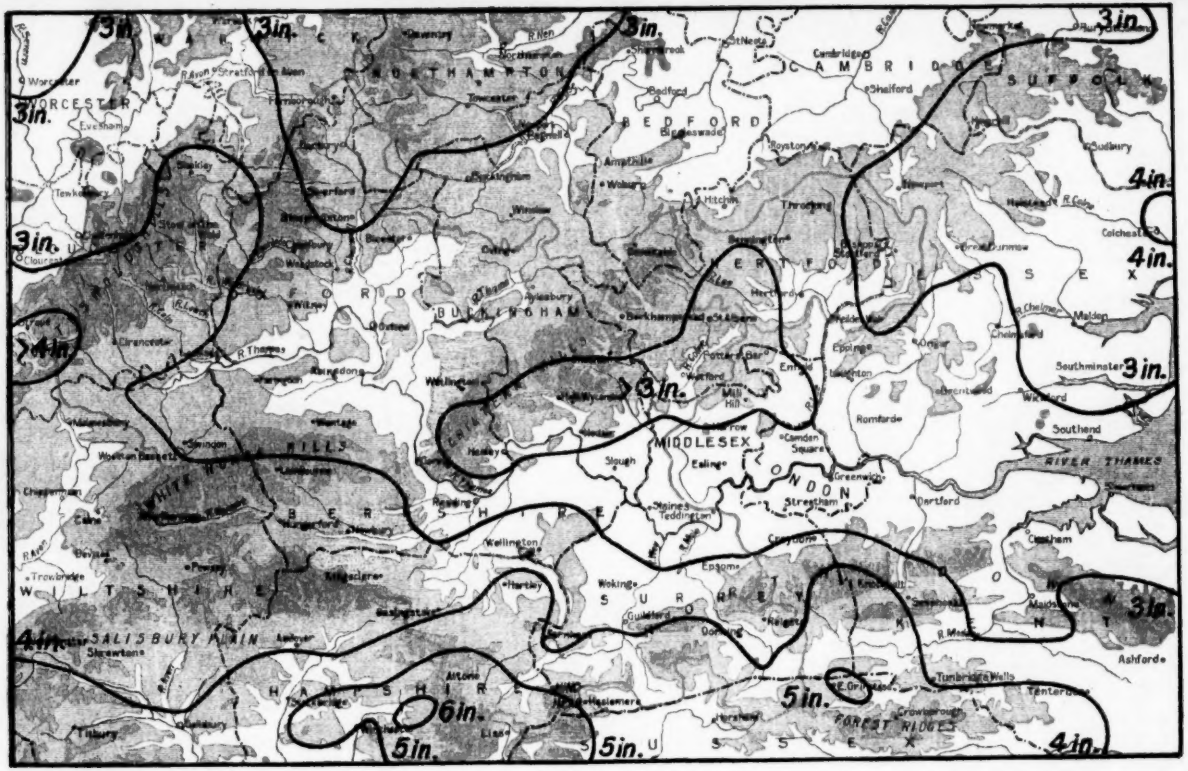
"The Relation of Atmospheric Electrical Variation to the Incidence of Epileptic Fits" was discussed by Dr. A. G. S. Mahomed on December 8th at the Royal Society of Medicine.

At the meeting of the Geographical Association at Birkbeck College on January 6th Miss L. Winchester of Liverpool University read a paper on "Some Climatic Problems of Modern Palestine," the outstanding problem being the seriousness of the summer drought and the adequate storage of water from winter rains.

Meteorological Books.—Mr. James Smith, of Pinewood, Crathes, Aberdeenshire, writes that he wishes to dispose of a number of meteorological books and instruments and would be glad to hear of likely purchasers. Any communications on the subject should be sent direct to Mr. Smith.

A USEFUL calendar has been received from the Pluvius Department of the Eagle, Star and British Dominions Insurance Company. On the front is shown a time-dial, which gives summer time as well as the hours on the 24-hour clock and the 12-hour clock, while tables for the conversion of inches to millimetres and of inches to millibars together with the specification of the Beaufort scale of wind-force are set out on the back.

THAMES VALLEY RAINFALL —— JANUARY, 1922.



The Weather of January, 1922.

THE weather of January, 1922, was typically variable. In the British Isles both very low day temperatures and very high day temperatures obtained with greater frequency than usual. Temperature in Scandinavia and the Netherlands has been very low. Rainfall in the British Isles was above normal generally and sunshine approximately normal. The amount of snow and its persistence was distinctly more than normal, especially along the Scots Border, where road traffic was seriously affected. Perhaps the outstanding feature was the prevalence of gales and high winds. On only eight days of the month were gale warnings not flying on some part of the coasts of the British Isles. The loss of shipping and human life was unfortunately very heavy.

The pressure distribution of the first day of the month gave a westerly type of weather. An area of high pressure was centred over Portugal and a depression between Iceland and Norway. The weather was generally overcast and considerable amounts of rain fell over the whole area. Temperature in the British Isles was above normal. By the morning of the 2nd, the depression, moving quickly eastwards, was centred over Scandinavia. The cold north-westerly wind behind this depression caused a great fall in temperature, and snow showers occurred in the north of Scotland. During the 3rd, 4th and 5th, the "high" over Portugal moved out over the Atlantic in a north-westerly direction, while the Scandinavian low spread south-east, giving a cold northerly current over north-west Europe. Fair weather was general, but some snow storms occurred and thunder was reported from Banff on the 3rd and Yarmouth on the 4th. A backing wind and falling barometer in Iceland and the western districts of the British Isles on the evening of the 5th indicated the approach of further disturbances from the west, and during the 6th, 7th and 8th the westerly type was re-established with a rise of temperature spreading in from the west.

Rain was particularly heavy in Switzerland on Jan. 8th, 35 mm. falling at Zurich and 33 mm. at Geneva.

From the 8th to the 11th a sequence of changes in the pressure distribution, closely resembling that from the 1st to the 5th, occurred. On the 9th a broad, warm, westerly current spread from France to Iceland. Heavy rain occurred in many places, 24 mm. being reported from Eskdalemuir. On the 10th the wind veered behind a depression crossing Norway, with a consequent fall of temperature over the British Isles. A thunderstorm occurred at Wick, and heavy rain fell in northern Germany. The 11th was a colder, brighter day, with snow and hail showers and lightning at Cranwell.

On the morning of the 12th a tongue of high pressure extended from the Azores over Ireland. This "high" moved eastwards over the British Isles, giving a fine, cold day with keen frosts at night and local fogs. During the 13th a V-shaped depression cut into the belt of high pressure, so that pressure was high over Scandinavia and the Azores and comparatively low over the British Isles. This Scandinavian "high" persisted for the rest of the month and was the chief feature of the weather map. On the 14th the V had developed into a typical cyclone over southern England, but rapidly diminished in intensity, having no supply of warm air. The temperature in all districts was low, and snow fell in Scandinavia, Denmark, and north Germany from a cold north-east wind.

On the morning of the 15th a warm southerly current was touching the western districts of the British Isles and the barometer falling very quickly. During the day a depression moved quickly across England, causing heavy rain or snow in all districts. By the morning of the 16th the centre of this depression was over the North Sea, and the cold north-west current behind it had joined up with the cold air over France, completely shutting off the supply of warm air. The depression, which had been moving very quickly, became almost stationary and proceeded to fill up, so that by the evening of the 18th it was almost unrecognisable on the map.

From the 18th the "high" over the Baltic gradually increased in intensity and extended its influence eastwards, while pressure remained low over the Atlantic, west of Ireland, giving low temperatures and easterly winds in southern Scandinavia and the Netherlands, but fairly warm weather in the western half of the British Isles and Iceland, where the air supply was drawn from the southern Atlantic. Temperatures on the morning of the 23rd may be quoted as typical of the conditions before the cold easterly drift along the southern side of the Baltic "high" had affected the west of the British Isles. On the Baltic coast of Germany temperatures ranged about 0° F., Hamburg 16° F., The Helder 30° F., Yarmouth 38° F., Pembroke 48° F., Valencia 53° F., Reykjavik (Iceland) 49° F., and the coast of Norway 36° F. These can be compared with the same places two days later on the morning of the 25th: Baltic coast of Germany 0° F., Hamburg 12° F., The Helder 21° F., Yarmouth 36° F., Pembroke 32° F., Valencia 37° F., Reykjavik 34° F. On the Norwegian coasts temperatures were irregular from 41° F. to 30° F., the higher temperatures probably being due to a Föhn effect over the Scandinavian hills.

The very thick fog which occurred in London and elsewhere in England on the 22nd was occasioned by the conjunction of the very cold easterly air with the much warmer air from the south.

On the 25th a depression appearing off the south-west coast of the British Isles moved north slowly, bringing a warmer air supply which gradually spread from the west across the British Isles. The meeting place of the two currents—the warm from the depression to the west and the cold from the Scandinavian "high"—was clearly marked, particularly on the weather map of the 26th, as a narrow ribbon, extending from Brussels to Aberdeen along the east coast of Britain, over which rain was falling and mists or fogs occurred.

By Saturday, 28th, the whole of the British Isles and northern France were definitely in this warmer current, and the anticyclone over the Baltic had diminished in intensity.

The last two or three days of the month were mild and unsettled in the British Isles and France owing to the warm air coming round the large Atlantic depression. The weather in Scandinavia, North Germany and the Netherlands remained cold but, with the anticyclone diminishing in intensity and thus permitting the slow drifting in of warmer air, the temperature was slowly rising.

R. A. W.

There was a general snowfall over France on the 15th; around Amiens the snow was accompanied by a violent gale. The lowest temperature recorded seems to have been 3° F. at Pontarlier (Doubs). A hurricane swept the coast of Portugal on the night of the 17th, causing much loss of life and general damage. Northern Germany experienced a spell of severe cold near the end of the month; Kiel Harbour was completely frozen over for the first time in many years. In Switzerland the depth of snow has increased, and the facilities for winter sports are more nearly normal.

At the beginning of the month the seven months' drought in Northern Italy was still continuing. Heavy rain and snow fell in the Calabrian provinces on the 10th and subsequent days, and on the night of the 17th the drought in the north was broken by a considerable fall of snow over the whole of the country between Venice and Milan. In the Arlberg district of the Rhætian Alps snow-avalanches interrupted the Paris–Vienna railway services for several days.

On the 4th a violent gale and hailstorm caused the destruction of several sailing vessels at Salonika. Later in the month twenty persons were killed by lightning during a severe thunderstorm in the Lebanon.

A message from *The Times* of the 17th states that Indian crop prospects continue to be good, though more rain is needed in the Punjab and parts of Madras.

A Sydney cable, dated on the 27th, reports rainfall varying from 6 mm. to 25 mm. over New South Wales.

(*Continued on* p. 32.)

Rainfall Table for January 1922.

STATION.	COUNTY.	Aver. 1881–1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·86	2·81	71	151	·70	18	20
Tenterden (View Tower)	*Kent*	2·15	4·02	102	187	·78	19	19
Arundel (Patching Farm)	*Sussex*	2·60	4·31	109	166	·69	19	20
Fordingbridge (Oaklands)	*Hampshire*	2·76	4·77	121	173	·91	18	25
Oxford (Magdalen College)	*Oxfordshire*	1·72	2·29	58	133	·34	13	22
Wellingborough (Swanspool)	*Northampton*	1·85	3·42	87	185	·97	15	22
Hawkedon Rectory	*Suffolk*	1·74	3·39	86	195	·45	15	22
Norwich (Eaton)	*Norfolk*	1·96	5·20	132	265	·63	4	25
Launceston (Polapit Tamar)	*Devon*	3·72	5·20	132	140	·65	15	27
Sidmouth (Sidmount)	„	2·86	4·39	112	154	·74	30	23
Ross (County Observatory)	*Herefordshire*	2·42	3·50	89	145	·42	15	23
Church Stretton (Wolstaston)	*Shropshire*	2·53	4·75	121	188	·53	3, 28	25
Boston (Black Sluice)	*Lincoln*	1·62	2·21	56	136	·30	19	22
Worksop (Hodsock Priory)	*Nottingham*	1·77	2·98	75	168	·48	26	20
Mickleover (Clyd House)	*Derbyshire*	2·02	3·62	92	179	·86	26	20
Southport (Hesketh Park)	*Lancashire*	2·55	3·83	97	150	·80	15	22
Harrogate (Harlow Moor Ob.)	*York, W. R.*	2·44	3·98	101	163	·68	27	24
Hull (Pearson Park)	„ *E. R.*	1·80	2·82	72	157	·63	15	23
Newcastle (Town Moor)	*North'land*	2·04	2·94	75	144	·52	25	20
Borrowdale (Seathwaite)	*Cumberland*	13·28	9·80	249	74	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	3·78	4·55	116	120	·85	15	27
Haverfordwest (Gram. Sch.)	*Pembroke*	4·61	6·25	159	136	·81	20	24
Aberystwyth (Gogerddan)	*Cardigan*	4·09	5·83	148	143	1·04	15	20
Llandudno	*Carnarvon*	2·58	3·39	86	131	·53	16	23
Dumfries (Cargen)	*Kirkcudbrt.*	3·99	5·67	144	142	·87	15	20
Marchmont House	*Berwick*	2·25	2·93	74	130	·37	13	21
Girvan (Pinmore)	*Ayr*	4·72	7·11	181	151	·97	18	24
Glasgow (Queen's Park)	*Renfrew*	3·34	3·40	86	102	·40	8, 9	23
Islay (Eallabus)	*Argyll*	4·68	7·24	184	155	1·17	15	28
Mull (Quinish)	„	5·60	6·43	163	115	1·20	17	24
Loch Dhu	*Perth*	9·10	12·05	306	132	1·95	1	24
Dundee (Eastern Necropolis)	*Forfar*	1·95	3·35	85	172	·46	18	21
Braemar (Bank)	*Aberdeen*	3·08	6·59	167	214	·87	28	29
Aberdeen (Cranford)	„	2·38	4·80	122	202	·83	15	24
Gordon Castle	*Moray*	2·02	2·78	71	138	·40	1	28
Fort William (Atholl Bank)	*Inverness*	9·58	5·46	139	57	·68	31	25
Alness (Ardross Castle)	*Ross*	3·80	4·16	106	109	·67	15	20
Loch Torridon (Bendamph)	„	9·40	7·49	190	80	1·02	15	20
Stornoway	„	5·17	5·82	148	113	·93	15	26
Loch More (Achfary)	*Sutherland*	7·28	6·12	155	84	1·25	1	23
Wick	*Caithness*	2·46	3·26	83	133	·70	1	22
Glanmire (Lota Lodge)	*Cork*	4·30	5·75	146	134	·75	20	23
Killarney (District Asylum)	*Kerry*	5·92	7·35	187	124	1·14	17	29
Waterford (Brook Lodge)	*Waterford*	3·69	4·49	114	122	·60	20,27	22
Nenagh (Castle Lough)	*Tipperary*	3·96	4·79	122	121	·80	17	26
Ennistymon House	*Clare*	4·20	7·07	180	168	·81	28	27
Gorey (Courtown House)	*Wexford*	3·12	3·66	93	117	·69	20	23
Abbey Leix (Blandsfort)	*Queen's Co.*	3·28	3·67	93	112	·48	15	23
Dublin (FitzWilliam Square)	*Dublin*	2·29	2·28	58	100	·40	25	21
Mullingar (Belvedere)	*Westmeath*	3·21	3·31	84	103	·50	14	24
Woodlawn	*Galway*	3·82	..	..	..	..	..	..
Crossmolina (Enniscoe)	*Mayo*	5·24	6·06	154	116	·66	14	30
Collooney (Markree Obsy.)	*Sligo*	3·90	5·25	133	135	·68	14	27
Seaforde	*Down*	3·15	3·80	97	121	·61	18	24
Ballymena (Harryville)	*Antrim*	3·71	5·24	133	141	·95	14	29
Omagh (Edenfel)	*Tyrone*	3·54	5·16	131	146	·61	8	24

Supplementary Rainfall, January 1922.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	2·40	61
,,	Sevenoaks, Speldhurst	3·99	101
,,	Hailsham Vicarage	4·26	108
,,	Totland Bay, Aston	5·06	129
,,	Ashley, Old Manor Ho.	5·05	128
,,	Grayshott	5·44	138
,,	Ufton Nervet	2·90	74
III.	Harrow Weald, Hill Ho.	3·17	81
,,	Pitsford, Sedgebrook	3·56	90
,,	Chatteris, The Priory.	2·15	55
IV.	Elsenham, Gaunts End	3·45	88
,,	Lexden, Hill House	4·03	102
,,	Aylsham, Rippon Hall	5·17	131
,,	Swaffham	3·42	87
V.	Devizes, Highclere	3·27	83
,,	Weymouth	4·12	105
,,	Ashburton, Druid Ho.	6·97	177
,,	Cullompton	4·60	117
,,	Hartland Abbey	3·96	101
,,	Penzance, Trengwainton	6·12	155
,,	St. Austell, Trevarna.	6·83	173
,,	Crewkerne Merefield Ho	5·88	149
VI.	Clifton, Stoke Bishop.	..	..
,,	Ledbury, Underdown.	3·96	101
,,	Shifnal, Hatton Grange	3·87	98
,,	Ashbourne, Mayfield.	4·89	124
,,	Barnt Green, Upwood	3·18	81
,,	Blockley, Upton Wold	3·67	93
VII.	Leicester, Town Hall Sq.	3·11	79
,,	Grantham, Saltersford	2·13	54
,,	Louth, Westgate	3·50	89
,,	Mansfield, West Bank	4·18	106
VIII.	Nantwich, Dorfold Hall	3·83	97
,,	Bolton, Queen's Park.	4·79	122
,,	Lancaster, Strathspey.	3·78	96
IX.	Wath-upon-Dearne	3·25	83
,,	Bradford, Lister Park.	4·54	115
,,	West Witton	..	..
,,	Scarborough, Scalby	4·15	105
,,	Middlesbro', Albert Pk.	1·77	45
,,	Mickleton	3·50	89
X.	Bellingham	6·84	174
,,	Ilderton, Lilburn	4·04	103
,,	Orton	5·68	129
XI.	Llanfrechfa Grange	4·16	106
,,	Treherbert, Tyn-y-waun	9·12	232
,,	Carmarthen Friary	5·99	152
,,	Lampeter, Falcondale	6·35	161
,,	Cray Station	8·00	203
,,	B'ham W.W., Tyrmyndd	9·07	230
,,	Lake Vyrnwy	7·83	199
,,	Llangynhafal, P. Drâw	4·10	104
,,	Oakley Quarries	8·53	217
,,	Dolgelly, Bryntirion	6·63	168
,,	Snowdon, L. Llydaw.	17·14	435
,,	Lligwy	3·04	77
XII.	Stonecykirk, Ardwell Ho.	6·11	155
,,	Carsphairn, Shiel	10·42	265
XII.	Langholm, Drove Rd.	5·38	137
XIII.	Ettrick Manse	4·79	122
,,	North Berwick Res.	1·83	47
,,	Edinburgh, Royal Ob.	1·41	36
XIV.	Biggar	3·34	85
,,	Leadhills	13·92	354
,,	Kilmarnock, Agric. Coll.	3·15	80
XV.	Dougarie Lodge	5·72	145
,,	Oban	4·77	121
,,	Inveraray Castle	9·24	235
,,	Holy Loch, Ardnadam	8·10	206
XVI.	Loch Venachar	7·40	188
,,	Blaircreach	11·46	291
,,	Loch Rannoch, Dall	6·84	174
,,	Blair Atholl	5·26	134
,,	Coupar Angus	4·39	111
,,	Montrose Asylum	3·94	100
XVII.	Logie Coldstone, School	5·16	131
,,	Fyvie Castle	5·22	133
,,	Grantown-on-Spey	2·72	69
XVIII.	Kingussie, Fasnakyle	4·28	109
,,	Fort Augustus	3·06	78
,,	Loch Quoich, Loan	14·90	379
,,	Fortrose	2·70	69
,,	Faire-na-Squir	4·68	119
,,	Skye, Dunvegan	6·33	161
XIX.	Loch Carron, Plockton	4·87	124
,,	Dornoch, St. Gilberts	2·70	69
,,	Tongue Manse	3·78	96
XX.	Melvich Schoolhouse	4·06	103
,,	Dunmanway Rectory	9·81	249
,,	Mitchelstown Castle	3·79	96
,,	Gearahameen	1·50	38
,,	Darrynane Abbey	7·94	202
,,	Cashel, Ballinamona	3·68	93
,,	Roscrea, Timoney Pk.	3·09	79
,,	Foynes	4·52	115
,,	Broadford, Hurdlesto'n	4·58	116
XXI.	Kilkenny Castle	3·25	83
,,	Rathnew, Clonmannon	3·89	99
,,	Hacketstown Rectory	4·51	115
,,	Balbriggan, Ardgillan	2·70	69
,,	Drogheda	2·35	60
,,	Athlone, Twyford	2·86	73
XXII.	Castle Forbes Gdns.	4·07	103
,,	Ballynahinch Castle	8·11	206
,,	Galway Grammar Sch.	3·53	90
XXIII.	Westport House	5·35	136
,,	Enniskillen, Portora	4·08	104
,,	Armagh Observatory	3·31	84
,,	Warrenpoint	3·93	100
,,	Belfast, Cave Hill Rd.	3·88	99
,,	Glenarm Castle	5·25	133
,,	Londonderry, Creggan	4·16	106
,,	Sion Mills	4·40	112
,,	Milford, The Manse	4·85	123
,,	Narin, Kiltoorish	4·83	123
,,	Killybegs, Rockmount	6·41	163

Climatological Table for t

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. fro Norm
	mb.	mb.	°F.		°F.		°F.	°F.	°F.	°F.
London, Kew Observatory	1013·6	−1·4	81	19	41	31	71·1	54·5	62·8	+1
Gibraltar	1015·4	+0·2	91	3	61	11, 13	81·3	67·6	74·5	−1
Malta	1013·6	−0·8	93	1	62	26	84·2	73·3	78·7	+0
Sierra Leone	1013·0	−0·3	86	1, 5	69	25	82·4	72·5	77·5	−0
Lagos, Nigeria	1014·1	+0·5	85	31	71	21	83·0	73·7	78·3	+1
Kaduna, Nigeria	1014·2	+0·4	90	26	64	31	81·5	66·9	74·2	+0
Zomba, Nyasaland	1017·2	+1·0	81	9, 18, 28	45	5	75·9	54·3	65·1	+0
Salisbury, Rhodesia	1018·7	−0·4	83	11	35	1	75·2	42·8	59·0	−0
Cape Town	1020·9	+0·7	72	24	39	10	59·9	46·0	52·9	−2
Johannesburg	1022·1	−0·1	73	18	26	10	64·8	42·1	53·5	−0
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	77	17	22	3	66·2	33·5	49·9	−2
Calcutta, Alipore Obsy.	999·3	−1·7	91	10	76	26	87·5	78·7	83·1	+0
Bombay	1004·9	−0·8	86	4	76	10	83·8	77·2	80·5	−0
Madras	1005·5	0·0	98	23	73	25	93·6	77·6	85·6	−0
Colombo, Ceylon	1009·4	+0·5	87	17	72	10	85·3	77·1	81·2	−0
Hong Kong	1003·6	−1·6	92	22	74	8	87·4	78·6	83·0	+0
Sandakan	..	..	92	16, 18	72	3, 29, 30	88·1	75·1	81·6	−0
Sydney	1021·4	+3·2	74	10	40	6	64·8	45·2	55·0	+0
Melbourne	1021·2	+3·2	67	21	36	3	57·5	43·5	50·5	−0
Adelaide	1023·2	+4·0	75	21	37	6	62·0	44·3	53·1	−0
Perth, Western Australia	1021·2	+2·4	79	29	41	26	65·7	48·5	57·1	+1
Coolgardie	1022·1	+2·8	80	31	35	10	66·4	43·2	54·8	+1
Brisbane	1022·3	+3·3	75	27	42	6	67·9	49·2	58·5	−2
Hobart, Tasmania	1014·2	+0·6	65	21	32	1, 19	54·5	41·1	47·8	−0
Wellington, N.Z.	1015·7	+1·0	60	23	31	7	55·7	42·3	49·0	+0
Suva, Fiji	1014·6	+0·3	85	5	59	10	83·9	62·0	72·9	−0
Kingston, Jamaica	1014·3	+0·6	93	22	71	25	90·2	73·0	81·6	+0
Grenada, W.I.	1010·5	−2·1	90	9	70	10	85·1	74·7	79·9	+0
Toronto	1017·3	+1·9	91	30	47	22	78·4	57·6	68·0	+1
Winnipeg	1014·1	+0·2	94	31	41	20	76·3	51·8	64·1	+1
St. John, N.B.	1016·3	+0·9	77	3	46	26	68	52	60	−0
Victoria, B.C.	1017·6	+0·4	76	7	48	11	65·8	50·9	58·3	−1

LONDON, KEW OBSERVATORY.—Mean speed of wind 7·4 mi/hr; 3 days with thun heard.

GIBRALTAR.—1 day with thunder heard.

MALTA.—Prevailing wind direction NWly; 1 day with thunder heard.

SIERRA LEONE.—Prevailing wind direction SW; 3 days with thunder heard.

MADRAS.—15 days with thunder heard.

COLOMBO, CEYLON.—Prevailing wind direction WSW, mean speed 5·6 mi/hr; 2 days w thunder heard. Vigorous thunderstorms inland but not at Colombo.

MELBOURNE :— November 1920...	1015·4	+1·3	88	8	41	3	70·7	52·6	61·7	+

Abs. max. in sun 148° F.

KADUNA, NIGERIA.—Pressure diffs. from normal for Jan. to July 1921 should rea

itish Empire, August 1921.

EMPERATURE Mean	Absolute Min. on Grass ° F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	Amount mm.	Diff. from Normal mm.	Days	BRIGHT SUNSHINE Hours per day	Percentage of possible	STATIONS
7·8	33	66	6·5	0·99	25	− 32	6	5·4	37	London, Kew Observatory.
3·1	57	74	2·5	0·28	7	+ 3	1	..	..	Gibraltar.
2·7	62	68	2·1	0·23	6	+ 3	4	10·2	76	Malta.
3·7	..	84	8·7	48·56	1233	+319	29	..	..	Sierra Leone.
3·1	69	78	9·4	3·53	90	+ 22	16	..	..	Lagos, Nigeria.
0·5	..	89	..	11·73	298	+ 2	18	..	..	Kaduna, Nigeria.
..	..	77	3·5	0·70	18	+ 10	3	..	..	Zomba, Nyasaland.
0·9	28	49	1·2	0·00	0	− 2	0	..	..	Salisbury, Rhodesia.
0·7	..	78	5·8	4·04	103	+ 16	15	..	..	Cape Town.
0·3	25	47	0·6	trace	trace	− 9	0	10·1	91	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
7·3	..	56	1·5	0·00	0	− 12	0	..	..	Bloemfontein.
0·3	74	81	9·2	16·82	427	+118	19*	..	..	Calcutta, Alipore Obsy.
5·7	71	83	8·3	10·37	263	− 97	28*	..	..	Bombay.
5·6	..	77	6·3	7·28	185	+ 60	9*	..	..	Madras.
7·4	71	76	8·8	3·44	87	+ 2	23	..	..	Colombo, Ceylon.
7·9	..	82	6·2	15·45	392	+ 27	10	8·0	62	Hong Kong.
6·1	..	82	..	9·88	251	+ 46	12	..	..	Sandakan.
9·7	30	62	2·1	0·95	24	− 55	5	8·6	79	Sydney.
7·6	34	74	6·4	3·06	78	+ 32	17	..	..	Melbourne.
8·5	27	67	5·1	2·20	56	− 8	14	5·8	54	Adelaide.
3·4	32	68	4·6	3·68	93	− 50	16	..	..	Perth, Western Australia.
9·5	31	50	4·3	1·57	40	+ 14	7	..	..	Coolgardie.
1·2	31	63	4·1	0·41	10	− 47	7	..	..	Brisbane.
8·7	23	69	6·5	2·52	64	+ 18	17	..	..	Hobart, Tasmania.
.	21	78	5·3	3·25	83	− 33	14	5·7	55	Wellington, N.Z.
8·1	..	94	..	11·30	287	+ 78	17	..	..	Suva, Fiji.
..	..	75	6·7	1·22	31	− 62	9	..	..	Kingston, Jamaica.
5·7	..	75	4·7	10·60	269	+ 30	23	..	..	Grenada, W.I.
1·0	43	75	4·0	2·07	53	− 17	9	..	..	Toronto.
0·2	..	81	3·7	2·46	62	+ 2	10	..	..	Winnipeg.
5·4	42	78	4·5	2·42	61	− 37	6	..	..	St. John, N.B.
3·7	41	80	4·0	0·85	22	+ 5	8	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

HONG KONG.—Prevailing wind direction S, mean speed 8·5 mi/hr; 10 days with thunder heard.

MELBOURNE.—All northern rivers in flood.

BRISBANE.—Mean temp. and mean max. lowest on record for August.

WELLINGTON, N.Z.—3 days with hail, 1 day with thunder heard, 1 day with fog.

GRENADA.—Prevailing wind direction E; 3 days with thunder heard.

5·7	34	61	6·5	3·21	82	+ 24	8	..	..	MELBOURNE :— November 1920

Jan. + 2·8, Feb. + 1·2, Mar. + 1·9, Apl. + 2·1, May + 0·1, June 0·0, July + 0·5.

A very severe hurricane, following a heavy fall of hail and snow, raged in New York City on the 11th. The wind is said to have attained a force of 100 m.p.h., and in many places pedestrians could only progress in groups or by holding on to improvised life lines. Three persons were killed and fifty injured. Eight days later one of the thickest fogs ever observed by the Weather Bureau occurred, shipping being unable to enter the harbour.

The special message from Brazil states that rain has been generally deficient except in the coffee and wheat regions of San Paulo and Rio Grande. Temperatures were above normal over the whole country, and the anticyclonic conditions which bring the cool, north-east trade wind to the coasts at this season of the year were absent.

The rainfall was above the average generally over the British Isles, failing to reach this amount only in the English Lake District and the north-west of Scotland. The greater portion of the centre and south-east of England, and parts of the east of Scotland and west of Clare received more than 150 per cent. of the average. In Norfolk and Aberdeenshire more than twice the average occurred, reaching as much as 265 per cent. of the average at Norwich, where the rainfall was the heaviest recorded since records began in 1865. The distribution of rainfall was thus such as to bring the dry period which was so prominent a feature of 1921, to an end, the fall being greatest in the districts where the drought had been most acute. It was also notable that heavy daily falls were remarkably few, only a small number of stations recording more than 25 mm. in one day. Falls of less than 50 mm. (2 inches) during the month were confined to the neighbourhood of the Wash, the Valley of the Tweed, and along the Firth of Forth. More than 250 mm. (10 inches) was recorded locally among the mountains of Central Wales, near Loch Lomond, in Western Inverness-shire, Kerry, Connemara, and Down.

The general rainfall for the counties expressed as a percentage of the averages, were England and Wales, 148; Scotland, 131; Ireland, 126; British Isles, 141.

In London (Camden Square), the mean temperature was 40·1° F. or 1·4° F. above the average. Duration of rainfall, 70·7 hours. Evaporation, 0·16 inch.

The staff of the Meteorological Office held their Third Annual Soirée on February 11th at the Merrick Rooms, Kensington, W The soirée took the form of a concert and dance; nearly 200 members of the staff and friends were present, Dr. G. C. Simpson, Mrs. Simpson and Sir Napier Shaw being among the number.